MSFC 105-Meter Drop Tube Undercooling and Nucleation Studies

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In order to improve present metals and alloys through space processing, it is necessary to first understand the effect of low-gravity processing on the structure and properties of the material. The effect of low gravity coupled with containerless processing is being studied using the MSFC 105-Meter Drop Tube Facility. This environment, achieved in both the drop tube and during a containerless space flight, is conducive to large degrees of undercooling before solidification of the metal occurs. Therefore this facility provides an ideal environment for undercooling and nucleation studies of undercooled metals.

In the past year, effort has been directed to supporting six flight and ground-based investigations. Approximately 600 research samples and a much larger number of test samples were processed in the drop tube in support or preparation for these investigations. The supported investigations and a brief description of the science objectives are listed below:

- Dr. Kelton of the Washington University: A study of the effect of low-gravity, containerless processing on the formation and properties of quasi-crystalline materials.
- Dr. Flemings of the Massachusetts Institute of Technology: An attempt to measure the viscosity and surface tension of undercooled metals samples by recording the shape and rate of the spreading front from a splat quenched sample.
- Dr. Johnson of Cal. Tech.: A study of the thermophyscial properties (heat capacity, surface tension, viscosity) of metallic glass forming materials.
- Dr. Bayuzick of Vanderbilt University: A measurement of the distribution of nucleation temperatures of undercooled metals and alloys.
- Dr. Grugel of University Space Research Associates: A study of the effect of undercooling on hypomontectic alloy systems.
- Dr. Robinson of MSFC: A study of the separation and undercooling phoneme in immiscible metal systems through low-gravity, containerless processing.

In addition to supporting the above named research efforts, the drop tube facility is actively supporting a study of the effect of welding in space on space suit materials in support of MSFC's Materials and Processes Laboratory.

Sponsor: Office of Life and Microgravity Sciences and Applications, NASA Headquarters

Biographical Sketch: Dr. Michael B. Robinson came to Marshall Space Flight Center in September 1976, and currently is a member of the Crystal Growth and Solidification Physics Branch in the Space Sciences Laboratory. He currently serves as project scientist for the MSFC 105-meter drop tube, for the modular electromagnetic levitator, and the German TEMPUS space flight electromagnetic levitator, scheduled to fly aboard the Space Shuttle on the International Microgravity Laboratory–2 mission. In addition, Robinson is currently co-investigator on two flight programs, one involving the study of the effect of microgravity on the nucleation distribution of pure metals, and the other involving directional solidification under microgravity conditions and influences of magnetic fields. He also serves as co-investigator on a ground-based research program involving undercooling, nucleation, and solidification studies. Robinson received his M.S. in physics from the University of Alabama in Huntsville and his Ph.D. in materials science from Vanderbilt University in May 1988.